CLAIMS

What is claimed is:

1. An optical apparatus for transmitting an optical signal, comprising:

a static filter that has wavelength dependent transmission;

a Faraday rotator;

a reflector; and

wherein the Faraday rotator makes a first change in polarization of the optical signal in a first direction and a second change in polarization of the optical signal received from the reflector in a second direction to produce a polarization of the optical signal that is substantially orthogonal to an initial polarization state of the optical signal.

2. The apparatus of claim 1, wherein the Faraday rotator has a nominally 45° rotation for linear polarization.

3. The apparatus of claim 1, further comprising: a lens positioned to image the optical signal to an optical fiber.

4. The apparatus of claim 3, wherein the lens is positioned between the optical fiber and the static filter.

5. The apparatus of claim 3, wherein the lens is positioned between the static filter and the Faraday rotator.

6. The apparatus of claim 3, wherein the lens is positioned between the Faraday rotator and the reflector.

7. The apparatus of claim 1, wherein the reflector is a high reflector.

8. The apparatus of claim, wherein the reflector reflects at least 50% of incident light.

9. The apparatus of claim 1, wherein the static filter includes dielectric films and a transparent substrate.

10. The apparatus of claim 1, wherein the static filter is an interference filter.

11. The apparatus of claim 1, wherein the static filter is a fiber based filter.

12. The apparatus of claim 1, wherein the static filter is a waveguide filter.

13. The apparatus of claim 1, further comprising:
a mode coupler coupled to an optical fiber and configured to create perturbations in the optical modes in the optical fiber and provide coherent coupling between two modes in the optical fiber.

14. The apparatus of claim 13, wherein the optical fiber has a cladding surrounding a core.

15. The apparatus of claim 13, wherein the mode coupler is selected from an acoustic grating, a UV grating, a bending grating and a stress induced grating.

16. The apparatus of claim 13, wherein the mode coupler includes an acoustic wave generator and an acoustic wave propagation member coupled to the optical fiber.

17. The apparatus of claim 13, wherein the mode coupler couples a first core mode to a second core mode.

18. The apparatus of claim 13 wherein the mode coupler couples a core mode to a cladding mode.

19. The apparatus of claim 13 wherein the mode coupler couples a cladding mode to a core mode.

20. -The apparatus of claim 13 wherein the mode coupler couples a cladding mode to a different cladding mode.

21. The apparatus of claim 13 wherein the mode coupler includes an acoustic wave generator that produces multiple acoustic signals with individual controllable strengths and frequencies, each of the acoustic signals providing a coupling between different modes traveling within the optical fiber.

22. The apparatus of claim 13, wherein the mode coupler includes a temperature controlled grating that is temperature tunable.

23. The apparatus of claim 13, wherein the mode coupler includes a stress induced grating that is stress tunable.

24. The apparatus of claim 13, wherein the mode coupler includes an acoustic wave generator that produces longitudinal waves.

25. The apparatus of claim 13, wherein the mode coupler includes an acoustic wave generator that produces torsional waves.

26. The apparatus of claim 13, wherein the mode coupler includes an acoustic wave generator that produces transverse waves.

27. The apparatus of claim 13, wherein the mode coupler includes an acoustic wave generator and a wavelength of an optical signal coupled between two different modes traveling within the optical fiber is

changed by varying the frequency of a signal applied to the acoustic wave generator.

28. The apparatus of claim 13, wherein the mode coupler includes an acoustic wave generator and an amount of an optical signal coupled between two different modes traveling within the optical fiber is changed by varying the amplitude of a signal applied to the acoustic wave generator.

29. An optical apparatus for transmitting an optical signal, comprising:

a static filter that has wavelength dependent transmission;

a Faraday rotator;

a variable optical attenuator that attenuates at least a portion of the optical signal;

a reflector; and

wherein the Faraday rotator makes a first change in polarization of the optical signal in a first direction, and a second change in polarization of the optical signal received from the reflector in a second direction to produce a polarization of the optical signal that is substantially orthogonal to an initial polarization state of the optical signal.

30. The apparatus of claim 29, wherein the Faraday rotator has a nominally 45° rotation for linear polarization.

31. The apparatus of claim 29, further comprising:

a lens positioned to image the optical signal to an optical fiber.

32. The apparatus of claim 29, wherein the variable optical attenuator is positioned between the static filter and the Faraday rotator.

33. The apparatus of claim 29, wherein the variable optical attenuator is positioned between the Faraday rotator and the reflector.

34. The apparatus of claim 31, wherein the variable optical attenuator is positioned between the lens and the static filter.

35. The apparatus of claim 31, wherein the lens is positioned between the optical fiber and the static filter.

36. The apparatus of claim 31, wherein the lens is positioned between the static filter and the Faraday rotator.

37. The apparatus of claim 31, wherein the lens is positioned between the Faraday rotator and the reflector.

38. The apparatus of claim 29, wherein the reflector is a high reflector.

39. The apparatus of claim 29, wherein the reflector reflects at least 50% of incident light.

40. The apparatus of claim 29, wherein the filter includes dielectric films and a transparent substrate.

41. The apparatus of claim 29, wherein the filter is an interference filter.

42. The apparatus of claim 29, wherein the filter is a fiber based filter.

43. The apparatus of claim 29, wherein the filter is a waveguide filter.

44. The apparatus of claim 29, further comprising:

a mode coupler coupled to an optical fiber and configured to create perturbations in the optical modes in the optical fiber and provide coherent coupling between a first mode to a second mode in the optical fiber.

45. The apparatus of claim 44, wherein the optical fiber has a cladding surrounding a core.

46. The apparatus of claim 44, wherein the mode coupler is selected from an acoustic grating, a UV grating, a bending grating and a stress induced grating.

47. The apparatus of claim 44, wherein the mode coupler includes an acoustic wave generator and an acoustic wave propagation member coupled to the optical fiber.

48. The apparatus of claim 44, wherein the mode coupler couples a first core mode to a second core mode.

49. The apparatus of claim 44 wherein the mode coupler couples a core mode to a cladding mode.

50. The apparatus of claim 44 wherein the mode coupler couples a cladding mode to a core mode.

51. The apparatus of claim 44 wherein the mode coupler couples a cladding mode to a different cladding mode.

52. The apparatus of claim 44 wherein the mode coupler includes an acoustic wave generator that produces multiple acoustic signals with individual controllable strengths and frequencies, each of the acoustic

signals providing a coupling between different modes traveling within the optical fiber.

53. The apparatus of claim 44, wherein the mode coupler includes a temperature controlled grating that is temperature tunable.

54. The apparatus of claim 44, wherein the mode coupler includes a stress induced grating that is stress tunable.

55. The apparatus of claim 44, wherein the mode coupler includes an acoustic wave generator that produces longitudinal waves.

56. The apparatus of claim 44, wherein the mode coupler includes an acoustic wave generator that produces torsional waves.

57. The apparatus of claim 44, wherein the mode coupler includes an acoustic wave generator that produces transverse waves.

58. The apparatus of claim 44, wherein the mode coupler includes an acoustic wave generator and a wavelength of an optical signal coupled between two different modes traveling within the optical fiber is changed by varying the frequency of a signal applied to the acoustic wave generator.

59. The apparatus of claim 44, wherein the mode coupler includes an acoustic wave generator and an amount of an optical signal coupled between two different modes traveling within the optical fiber is changed by varying the amplitude of a signal applied to the acoustic wave generator.

60. An optical apparatus for transmitting an optical signal, comprising:

a static filter that has wavelength dependent transmission;

a Faraday rotator;

a reflector positioned along a first optical path defined by the static filter, the Faraday rotator and the reflector, the reflector reflecting at least a portion of the optical signal back in a direction towards the Faraday rotator along an optical path that is not the first optical path; and

wherein the Faraday rotator makes a first change in polarization of the optical signal received from the static filter, and a second change in polarization of the optical signal received from the reflector to produce a polarization of the optical signal that is substantially orthogonal to an initial polarization state of the optical signal.

61. The apparatus of claim 60, wherein the Faraday rotator has a nominally 45° rotation for linear polarization.

62. The apparatus of claim 60, further comprising:

a lens positioned to image the optical signal to an optical fiber.

63. The apparatus of claim 62, wherein the lens is positioned between the optical fiber and the static filter.

64. The apparatus of claim 62, wherein the lens is positioned between the static filter and the Faraday rotator.

65. The apparatus of claim 62, wherein the lens is positioned between the Faraday rotator and the reflector.

66. The apparatus of claim 60, wherein the reflector is a high reflector.

67. The apparatus of claim 60, wherein the reflector reflects at least 50% of incident light.

68. The apparatus of claim 60, wherein the static filter includes dielectric films and a transparent substrate.

69. The apparatus of claim 60, wherein the static filter is an interference filter.

70. The apparatus of claim 60, wherein the static filter is a fiber based filter.

71. The apparatus of claim 60, wherein the static filter is a waveguide filter.

72. The apparatus of claim 60, further comprising:

a mode coupler coupled to an optical fiber and configured to create perturbations in the optical modes in the optical fiber and provide coherent coupling between a first mode to a second mode in the optical fiber.

73. The apparatus of claim 72, wherein the optical fiber has a cladding surrounding a core.

74. The apparatus of claim 72, wherein the mode coupler is selected from an acoustic grating, a UV grating, a bending grating and a stress induced grating.

75. The apparatus of claim 72, wherein the mode coupler includes an acoustic wave generator and an acoustic wave propagation member coupled to the optical fiber.

76. The apparatus of claim 72, wherein the mode coupler couples a first core mode to a second core mode.

77. The apparatus of claim 72, wherein the mode coupler couples a core mode to a cladding mode.

78. The apparatus of claim 72, wherein the mode coupler couples a cladding mode to a core mode.

79. The apparatus of claim 72, wherein the mode coupler couples a cladding mode to a different cladding mode.

80. The apparatus of claim 72, wherein the mode coupler includes an acoustic wave generator that produces multiple acoustic signals with individual controllable strengths and frequencies, each of the acoustic signals providing a coupling between different modes traveling within the optical fiber.

81. The apparatus of claim 72, wherein the mode coupler includes a temperature controlled grating that is temperature tunable.

82. The apparatus of claim 72, wherein the mode coupler includes a stress induced grating that is stress tunable.

83. The apparatus of claim 72, wherein the mode coupler includes an acoustic wave generator that produces longitudinal waves.

84. The apparatus of claim 72, wherein the mode coupler includes an acoustic wave generator that produces torsional waves.

85. The apparatus of claim 72, wherein the mode coupler includes an acoustic wave generator that produces transverse waves.

86. The apparatus of claim 72, wherein the mode coupler includes an acoustic wave generator and a wavelength of an optical signal coupled between two different modes traveling within the optical fiber is changed by varying the frequency of a signal applied to the acoustic wave generator.

87. The apparatus of claim 72, wherein the mode coupler includes an acoustic wave generator and an amount of an optical signal coupled between two different modes traveling within the optical fiber is changed by varying the amplitude of a signal applied to the acoustic wave generator.